Ontario Geological Survey

# Northern Ontario Engineering Geology Terrain Study 41

# HEAVEN LAKE AREA

## (NTS 52H/SW)

## District of Thunder Bay

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ONTARIO MINISTRY OF NORTHERN DEVELOPMENT AND MINES
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B.G. Mollard and J.D. Mollard

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## MAP
## (accompanying report)

Map 5051 (coloured) – Northern Ontario Engineering Geology Terrain Study, Data Base Map, Heaven Lake (NTS 52H/SW). Scale 1:100 000.

Northern Ontario
Engineering Geology Terrain Study 41

# HEAVEN LAKE AREA

(NTS 52H/SW)

District of Thunder Bay

by

D.G. Mollard[1] and J.D. Mollard[2]

## 1.0 INTRODUCTION:

This report contains an inventory of regional engineering terrain conditions in the Heaven Lake map-area, District of Thunder Bay. The area, which covers NTS block 52H/SW, lies between Latitudes 49°00'N and 49°30'N and Longitudes 89°00'W and 90°00'W. This report forms part of a series of publications which provide similar terrain data for some 370 000 km$^2$ of northern Ontario.

The purpose of the mapping is to provide a guide for engineering and resource planning functions at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5051, accompanying this report).

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Interpretation of black and white aerial photographs, at a scale of approximately 1:50 000, formed the basis of the terrain mapping process. The interpretation was checked against published and unpublished maps and reports which documented previous field visits and observations. During the fall of 1977, roads in the map-area were traversed and observed terrain conditions recorded as further verification of the office studies. Thus, the Data Base Map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further discussion on the mapping techniques, legend format, and possible uses of this engineering geology information is available in the Ontario Engineering Geology Terrain Study Users' Manual (Gartner, Mollard, and Roed 1980), a companion publication to this series of maps and reports.

## 2.0 PHYSIOGRAPHY AND GEOLOGICAL SETTING:

Most of the Heaven Lake map-area lies within the Severn Upland physiographic unit, in the James Region of the Precambrian Shield. The eastern half of the area is underlain by Late Precambrian sediments and mafic intrusive rocks (diabase sills). Several small belts of Early Precambrian (Archean) mafic to intermediate metavolcanics occur in the central part, while the south-central part is dominated by metasediments of the same age. Early Precambrian felsic igneous and metamorphic rocks (including granite and granite gneiss) underlie the remainder of the map-area.

The surface is generally rolling, with large areas consisting of bedrock exposures or thin glacial deposits over bedrock. Organic terrain occurs in poorly drained depressions. Elevations range from less than 274 m in the northeast corner of the map-area to more than 565 m southeast of Sauerbrei Lake in the central part. The major drainage courses in the area are the Rivière des Iles and the Dog, Gull, Kabitotikwia, Pashkokagan and Eaglehead Rivers.

## 3.0 ENGINEERING TERRAIN UNITS:

The engineering terrain units mapped are identified in terms of four components: surface material, landform, topography, and drainage. Format of the legend used in the terrain mapping is described in detail in the Users' Manual (Gartner, Mollard, and Roed 1980). Landform is a very important component because surface and near-surface materials, topographic expression, and the surface and internal drainage conditions are all related to it. Consequently, the engineering terrain units are grouped, for descriptive purposes according to the dominant landform.

A particular landform can occur as the only component in a simple terrain unit, or as a dominant or subordinate component in a complex terrain unit. The dominant landform usually occupies more than half of a complex terrain unit. Where only one subordinate landform is shown, it usually occupies between 10 and 50 percent of the complex unit. Where two subordinate landforms are shown, the first covers the larger area. Landforms that occupy less than 10 percent of the terrain in a complex unit are rarely indicated in the terrain unit letter code. Where two or three landforms in a complex terrain unit consist of the same material, the landform letter symbols are connected by a dash. Examples of terrain unit letter codes which may occur in this map-area, and an explanation of each, are given in the Appendix.

A large number of complex terrain units has been mapped due to the widespread occurrence of irregular topography. Bedrock, which is situated at or near the ground surface throughout much of the map-area controls the topography and therefore the surface drainage conditions. Resource development and engineering planning considerations are complicated by these complex conditions.

Noteworthy occurrences of important landforms are described with respect to location, typical materials, topography, and drainage; their significance in geotechnical investigations, regional engineering planning and resource development is summarized.

## 3.1 BEDROCK KNOB (RN):

### 3.1.1 Description:

Bedrock knob landscape (RN) is characterized by an irregular bedrock surface having complex multiple slopes of varying steepness. The cover of glacial deposits overlying the bedrock knobs is generally thin and discontinuous. Much of the glacial overburden consists of bouldery, sand-rich till that was transported only a short distance by the ice.

### 3.1.2 Occurrence:

Bedrock knob terrain is scattered throughout the northern half of the Heaven Lake map-area, particularly around Cowan Lake in the western part, around Cheeseman Lake in the north-central part, and north and south of Circle Lake on the eastern margin. The bedrock knobs generally occur in association with other landforms such as ground moraine (RN(Mg), RN(MG/R)).

### 3.1.3 Engineering and Planning Significance:

Two principal engineering considerations are the large volumes of rock that must be excavated during construction and the generally uniform and solid foundation conditions at shallow depths. However, due to difficult topography and the existence of rock fractures, bedrock knob terrain is considered poor for most types of light construction and for waste disposal. Drilling and blasting are required during the construction of almost all types of engineering works.

## 3.2 BEDROCK RIDGE (RR):

### 3.2.1 Description:

The bedrock ridge unit (RR) consists of long, narrow, subparallel and intersecting bedrock ridges of varying height. Thickness of drift over the masked bedrock surface varies substantially over short distances. In general, it is relatively thin (1 to 2 m) on ridge tops and thicker on the lower slopes and in the depressions between rock ridges.

### 3.2.2 Occurrence:

Bedrock ridge terrain occurs extensively throughout the southern half of the Heaven Lake map-area, particularly between Rivière des Iles and Block Creek in the southwestern part and west of Eaglehead Lake in the southeastern part.

### 3.2.3 Engineering and Planning Significance.

The main construction problem is the large quantities of very hard rock that often must be excavated during construction. Drilling and blasting costs can be very high. Bedrock ridge terrain is considered poor for most types of engineering, construction, and resource development. It also has a low rating for waste disposal due to irregular relief, the presence of rock fractures near the ground surface, and the high cost of earthwork construction.

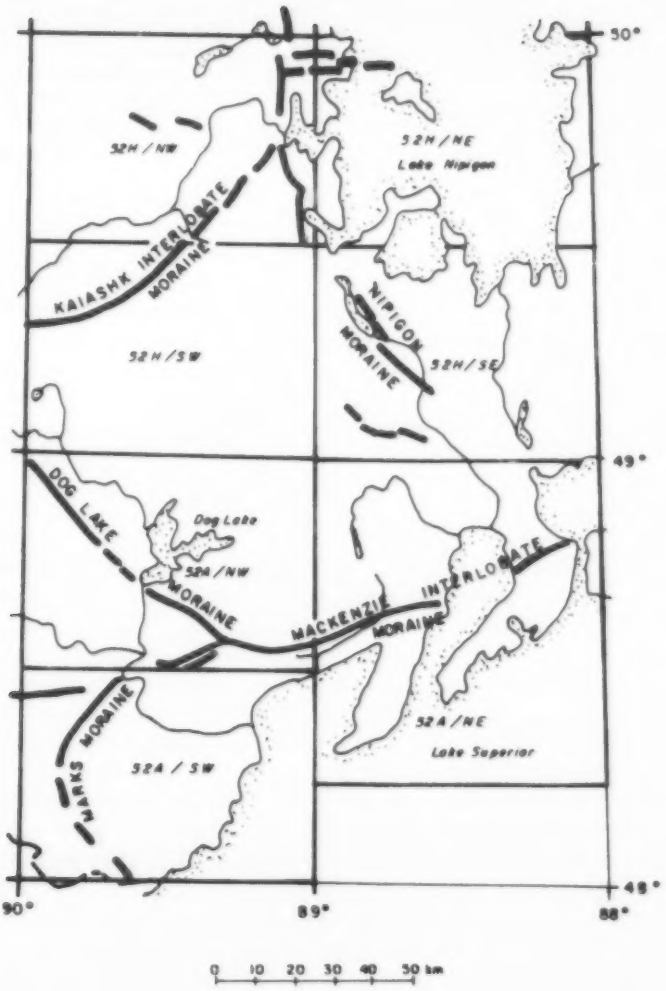
## 3.3 END MORAINE (ME):

### 3.3.1 Description:

End moraine (ME), which forms either prominent or inconspicuous till ridges, was deposited along the margin of the glacier. Although the ridges are usually long and narrow, they can be hummocky in places. End moraine consists largely of ice-deposited till and boulders, with minor inclusions of water-laid silt, sand, and gravel. Segments of end moraine, composed mainly of till, occur with hummocky moraine (MH), kames (GK), and ice-contact deltas (GD) in large moraine complexes which are identified by name in Figure 1.The bedrock surface is nearly always buried in areas of end moraine; there are exceptions, however, and in a few places end moraine ridges have a core of solid rock. The graphic symbol —●—●— is used to indicate major end moraines on the Data Base Map (OGS Map 5051, accompanying this report).

### 3.3.2 Occurrence:

End moraines are of minor importance in the Heaven Lake map-area. Examples occur northwest of the Gull River on the northern margin of the area, northeast of Little Pashkokagan Lake in the northeastern part, in the extreme northeast corner, and around Rinker Lake in the central part of the area.




NOTE: Moraine segments shown in the figure do not necessarily all occur on the Data Base Map accompanying this report.

**FIGURE 1 – MAP SHOWING MAJOR MORAINES IN NTS 52A AND 52H (MODIFIED FROM ZOLTAI 1965, FIGURE 3)**

### 3.3.3 Engineering and Planning Significance:

An important characteristic of end moraines is their variability. Layers of unsorted and unstratified material of varying sizes (i.e. till), can both underlie and overlie sequences of layered silt, sand, and gravel. In general, the boulder content of this landform is high. End moraines in the map-area commonly exhibit variable permeability and internal drainage, low compressibility, and high bearing strength. The water table is low in end moraine ridges. Where the unit consists of till that is high in sand- and gravel-sized material, and where sources of stratified sand and gravel are scarce, the coarse till may sometimes be crushed and used as a source of road-surfacing material. End moraines may present excavation difficulties during the building of roads and structures due to the abundance of small and large boulders.

## 3.4 GROUND MORAINE (MG):

### 3.4.1 Description:

The term "ground moraine", (MG) refers to an extensive deposit of till forming an undulating to rolling plain. Although till is generally composed of an assortment of particle sizes (including clay, silt, sand, gravel, cobbles, and boulders), till deposits in this map-area have a high sand and boulder content. The thickness of till in ground moraine varies from less than 1 m to many tens of metres. The landform is mapped as MG where the till is thick enough to mask any topographic effect of underlying bedrock. In general, the till layer forms a mantle less than 3 m thick over the bedrock and is mapped as MG/R. Till in ground moraine tends to be thicker in bedrock depressions and thinner over bedrock ridges and knobs.

### 3.4.2 Occurrence:

Ground moraine occurs extensively throughout the Heaven Lake map-area as a thin mantle of till overlying bedrock (MG/RP, MG/RN, MG/RR, MG/R). In a few areas, the till becomes sufficiently thick that the ground moraine no longer forms just a thin mantle; such units occur northwest of Armistice Lake in the northwestern part of the area, west of the Rivière des Iles in the southwest corner, and north and east of Eaglehead Lake in the southeastern part.

### 3.4.3 Engineering and Planning Significance:

The till in ground moraine is coarse and bouldery, and has moderate permeability and internal drainage, low compressibility, and high bearing strength. Water table position varies with relief, being lower beneath knolls and low ridges, and higher beneath depressions. The till in many of the depressions is covered by thin deposits of peat and muck.

The suitability of ground moraine for road and other light foundation construction is fair to good. The fact that the till often forms only a thin mantle over the bedrock (MG/R) has a great deal of significance in road building. Road construction through this type of terrain is difficult owing to the bouldery nature of the till and the probability of encountering bedrock in cuts. The suitability of ground moraine for waste disposal varies from poor to fair.

## 3.5 HUMMOCKY MORAINE (MH):

### 3.5.1 Description:

Although some hummocky moraine deposits formed along an active ice front, most of the sediments which make up this landform accumulated on the surface of stagnant glacial ice. In time, the buried ice melted and deposited a layer of unsorted till and, in places, washed glacial debris. Most hummocky moraine consists of steep-sided knobs and short ridges separated by undulating to flat plains and swampy kettle hole basins. Soil materials in hummocky moraine include till, usually as the dominant constituent, and subordinate amounts of stratified silt, sand, and gravel in pockets or lenses. Hummocky moraine can be very bouldery. Scattered kames (GK) are a common subordinate landform.

### 3.5.2 Occurrence:

Hummocky moraine is fairly common in the Heaven Lake map-area. It occurs north of Armistice Lake in the northwestern part of the area, around Demars Lake and southwest of Lac des Iles in the southwestern part, around Legris Lake in the central part, and at several locations in the northwestern part of the area.

### 3.5.3 Engineering and Planning Significance:

Engineering considerations include the large quantities of material that may have to be excavated during construction, a high content of boulders, and rapid changes in the nature of the materials. Pockets of sand and gravel constitute small sources of construction material of variable quality.

Although variable, most areas of hummocky moraine have moderate permeability and internal drainage, low compressibility, high bearing strength, and low shrink-and-swell potential. In depressions, the till deposits are commonly covered by thin, water-laid silt and clay, which in turn are overlain by peat and muck deposits. Hummocky moraine is considered fair to poor for general construction purposes and for waste disposal.

## 3.6 ICE-CONTACT DELTA (GD):

### 3.6.1 Description:

Esker deltas, kame deltas, and delta moraines are all varieties of the ice-contact delta. Some are quite large in area and important in terms of the volume of recoverable sand and gravel which they contain. Individual beds, consisting mainly of sand or gravel, are usually better sorted, cleaner, and less variable than stratified deposits in esker (GE) and kame (GK) landforms. The beds in this unit are also typically less folded and faulted and are more continuous. It is worth noting that materials in many ice-contact deltas are coarse (i.e. gravelly) on the north and northeast sides and finer (*i.e.* sandy) on the south and southwest sides. These conditions indicate the parts of the delta which were, respectively, closest to and farthest from the glacial front against which the delta was built.

### 3.6.2 Occurrence:

Ice-contact deltas occur northeast of Armistice Lake in the northwestern part of the map-area and south of Pashkokagan Lake in the central part. A large delta-esker complex trends northeasterly through the northwestern part of the area.

### 3.6.3 Engineering and Planning Significance:

Ice-contact deltas are good potential sources of concrete and blacktop aggregate. They are also favorable sites for the construction of airstrips, roads, and other types of engineering works. Because the subsoils are highly permeable, deltaic (GD) landforms are relatively poor areas for waste disposal. Larger deposits, however, are generally good ground water prospects, especially where sand and gravel horizons are thick and extend below the water table. Ice-contact deltas possess high bearing strength and good workability in wet weather. Slopes are stable and subsoils are well drained. Away from the steeply sloping margins of this landform, earthwork volumes and excavation costs are normally low. Reservoirs and sewage lagoons in ice-contact deltas must be lined to prevent excessive leakage.

## 3.7 ESKER (GE):

### 3.7.1 Description:

The ridged landform represented by the esker symbol (GE, >>>) also includes crevasse fillings. Both occur as long, narrow, sand and gravel ridges that can be winding or straight and may widen in places. Some of these elongate ice-contact stratified drift ridges include braided, branching, beaded, and kettled segments. Most of the ridges trend roughly parallel to the last direction of glacial flow. The cores of many eskers and crevasse fillings contain complexly layered units, consisting of sandy gravel and gravelly sand, that exhibit collapse structures (*i.e.* folds, faults, and pinch-outs of strata). Pockets and layers of waterlaid silt and fine sand, boulders, and till may occur within the central parts of eskers and crevasse fillings, as well as along their flanks.

The crests of larger eskers are often shown by the graphic symbol <<<. Eskers too small to be mapped as a seperate terrain unit are represented by the graphic symbol only.

### 3.7.2 Occurrence:

Eskers are common in the Heaven Lake map-area. They occur north of Bonnie Lake in the northwest corner of the area, south of Chisamore Lake in the western part, northwest and northeast of Whitton Lake in

the north-central part, at various locations around Pashkokagan and Little Pashkokagan Lakes in the eastern part, and in the southeast corner of the area. A large delta-esker complex trends northeasterly across the northwestern part of the area.

### 3.7.3 Engineering and Planning Significance:

Eskers and crevasse fillings are generally inferior to ice-contact delta and glacial outwash deposits as sources of good quality granular construction materials. Typically, the unit possesses high permeability and good internal drainage, low compressibility, high bearing strength, low frost susceptibility, and low shrink-and-swell potential. Where esker ridges are steep-sided, narrow, and winding, they may be unsuitable for use as transportation routes. They may trend in the wrong direction for route location purposes, but in regions that are dominated by large expanses of swamp and bedrock, large eskers are frequently considered as good route location possibilities. Where the sand and gravel in large eskers extends many metres below the water table, the unit represents a potential source of ground water for domestic and, possibly, municipal and industrial use.

## 3.8 OUTWASH PLAIN (GO):

### 3.8.1 Description:

Outwash deposits include plains, fans, deltas, and valley trains of varying sizes, all consisting mainly of sand and gravel. Most outwash sediments were drained from the front of a melting glacier and accumulated in flooded lowlands and valley bottoms. Although most outwash deposits formed in proglacial positions, some accumulated over masses of stagnant glacier ice, resulting in pitted or kettled surfaces. Outwash landscapes that show abandoned channel scars, braid bars, or deep kettle holes are commonly coarse in texture (i.e. gravelly and cobbly rather than sandy).

### 3.8.2 Occurrence:

An extensive outwash plain is located south of Armistice Lake in the west-central part of the map-area. Other sizeable outwash deposits are located north of Sauerbrei Lake in the north-central part of the area, along the Rivière des Iles in the southwestern part, and south of Eula Lake in the southeastern part. Many outwash plains are covered by

organic deposits. Outwash-kame complexes occur around Trojek Lake in the central part of the area and south of Rightangle Lake in the southeastern part.

### 3.8.3 Engineering and Planning Significance:

Outwash landforms almost always have high permeability and good internal drainage, low to very low compressibility, low shrink-and-swell tendencies, and high shear strength and bearing capacity, particularly where these granular deposits are confined. Granular materials in outwash landforms form stable slopes and are seldom susceptible to frost heave. Being level and well drained, the sediments in outwash plains are not easily eroded by running water. The boulder content is generally low. A high water table can be expected beneath kettle depressions. Extensive outwash plains provide excellent sites for the construction of roads and airstrips, and are often good sources of concrete and bituminous aggregate. They are good potential sites for ground water development, particularly where the granular deposits are deep and are recharged by water from nearby lakes and rivers.

## 3.9 GLACIOLACUSTRINE PLAIN (LP):

### 3.9.1 Description:

Sediments in glaciolacustrine plains consist of varved and massive, fine-grained materials deposited in glacial lake basins of varying size and depth. The proportions of clay, silt, and sand deposited at any particular location in these basins varies with depth of water in the former lake, distance from former shorelines, and the size of particles washed into the lake. Most clay, silt, and sand lacustrine deposits contain minor inclusions of till and scattered dropstones which were rafted into the lake on pieces of ice. In places, wave and current action in former glacial lakes eroded the surface of till deposits, producing thin patches of washed sand, gravel, and boulders that rest on till or bedrock. In other areas, bedrock knobs and ridges are surrounded by pockets of glaciolacustrine sediment. Glacial lake deposits usually consist of clay and silt (cLP, cmLP, mcLP) which accumulated in deep offshore waters at a depth where the bottom was no longer affected by wave action (generally below 10 m). Closer to shore, and at points where rivers discharged sandy materials into the lake, the deposits usually

consist of fine and medium sand with minor silt (sLP, smLP). Most of these sandy lacustrine deposits accumulated in deltaic environments.

### 3.9.2 Occurrence:

Glaciolacustrine deposits are limited to the northeastern part of the Heaven Lake map-area, specifically along and north of the Pashkokagan River. The sediments consist mainly of sand.

### 3.9.3 Engineering and Planning Significance:

Glaciolacustrine clay deposits (cLP) have high water retention capacity, low permeability, and poor internal drainage. These characteristics are largely controlled by a network of closely spaced joints. Generally, these landforms possess low density, low bearing strength, and moderate to high compressibility, unless the fine-grained sediments have been consolidated by the weight of overriding glacier ice or by the effects of desiccation. The clay sediments usually provide poor foundation conditions and can be difficult to work with heavy construction equipment during wet weather. Most clay plains in the map-area are level to gently sloping. The sides of river valleys which have been deeply incised into these fine deposits are frequently highly dissected and are susceptible to rill-and-gully erosion on freshly cut ditch slopes and highway back slopes. Higher and steeper natural and man-made slopes are subject to the development of small failures. Where these lacustrine materials carry a high proportion of silt or very fine sand, they are susceptible to frost heave and the formation of frost boils. Subsoil permeability ranges from low to nearly impervious; as noted above, this is largely dependent on the presence of a system of closely spaced joints. In locations where glaciolacustrine clay sediments are highly plastic, they have a tendency to shrink or swell with changes in moisture content. Bearing capacity, shear strength, and compressibility vary greatly with differences in previous loading history and, therefore, the natural moisture content. Bearing capacities can be low in wet areas, particularly where plastic clay soils are normally consolidated or only slightly consolidated.

Low-lying clay plains have a high water table and are subject to local flooding during spring runoff and heavy cloudbursts. During wet weather, the glaciolacustrine clay sediments have poor workability characteristics

for building roads and structures. This landform usually provides good sites for waste disposal because of its low permeability.

Lacustrine sand plains (sLP) contain mostly fine and medium sand with minor silt. Coarse sand, gravel, cobbles, boulders, and till are rare in these deposits. Sand plains are gently sloping to undulating and are well drained. A high water table may occur at sites located some distance from the ground water lowering effects of deep valleys and ravines. Sandy lacustrine materials are typically nonplastic and have high permeability, low compressibility, moderate to high bearing capacity, and high shear strength. They are generally not frost susceptible unless they contain significant amounts of silt and very fine sand. They represent fair to good terrain for most construction, especially that of roads and airstrips. They are poor for waste disposal due to the possibility of effluent seepage and ground water contamination.

## 3.10 ALLUVIAL PLAIN (AP):

### 3.10.1 Description:

Many alluvial deposits (AP) in this map-area consist of fine and medium sand at depth; these materials are commonly overlain by a silty upper stratum of variable thickness. Oxbows and abandoned channel segments occur where meandering streams cross landforms composed largely of loose silt and fine sand. Sediments beneath alluvial plains are finer textured where the material being carried by the stream was eroded from clay and silty clay glaciolacustrine deposits. The landform includes flood plains that have been eroded in till and are strewn with boulders, as well as segments of stream valleys where alluvial sediments range in texture from coarse sand to coarse gravel and cobbles. Long and complex alluvial plain systems sometimes include three constituent landforms: low alluvial terraces, alluvial flood plains, and stream channels.

### 3.10.2 Occurrence:

Alluvial plains are located along Armistice Creek in the northwestern part of the map-area, the Gull River in the north-central part, the Heaven River and Sauerbrei Creek in the central part, Block Creek in the south-central part, and Rivière des Iles in the southwestern part.

### 3.10.3 Engineering and Planning Significance:

Alluvial plains are subject to flooding. The water table is usually situated at or near the surface for much of the year; organic-filled depressions are common. Although some alluvial terraces, flood plains, and channel bottoms represent potential sources of sand and gravel for construction purposes, the high water table may cause problems during excavation of such materials. This landform is generally unsuitable for transportation routes, general construction, or waste disposal sites because of the high water table and risk of flooding.

## 3.11 SLOPEWASH SHEET (CW):

### 3.11.1 Description:

Slopewash sheets are almost always poorly expressed in airphotos. The presence of these sheets must therefore be inferred from depositional environments that are recognizable on the photos. They usually contain poorly sorted, poorly stratified, loosely deposited sediments that have been washed down the surfaces of moderately steep slopes by unconcentrated overland sheet flow or transported down steep slopes by frost action and soil creep processes. Most of these materials were probably transported and deposited in a periglacial climate. Slopewash deposits commonly merge upslope with piles of talus debris and downslope with till and fine-grained lacustrine sediments.

### 3.11.2 Occurrence:

Slopewash sheets of limited extent are found on steeper slopes in the southeast corner of the area and northeast of Lime Lake in the east-central part.

### 3.11.3 Engineering and Planning Significance:

Pits in this landform contain poorly sorted, poorly graded, dirty (silty) sand and angular rock particles of varying sizes. The material is usually too dirty to use as concrete or blacktop aggregate without being washed. Nevertheless, where these deposits are sufficiently thick and dry, the material can be crushed to produce a satisfactory road surfacing material. In general, slopewash deposits are thin and loose, and

may possess a loose openwork (*i.e.* porous) structure. Subsoils are often wet, even though the slopes may appear steep enough to be well drained. Seepages and springs are common occurrences. Engineering problems caused by slopewash terrain include poor geometrics in road design and relatively high cuts and fills during construction.

## 3.12 SAND DUNES (ED):

### 3.12.1 Description:

Dunes are composed of fine and medium sand that has been blown into ridges by wind action. Dune ridges range in height from 1 or 2 m to more than 5 m, and may be long, narrow, and either straight, arrowhead, or arcuate in plan view. Dunes usually overlie or occur downwind from sandy outwash plains and sandy glaciolacustrine plains.

The location of sand dune areas may also be indicated on the map by the graphic symbol .

### 3.12.2 Occurrence:

Sand dunes, indicated by the graphic symbol, occur in the vicinity of Gall and Eleph Lakes on the western margin of the map-area and northwest and southwest of Chisamore Lake in the west-central part.

### 3.12.3 Engineering and Planning Significance:

Sand dunes possess special characteristics of engineering significance. When denuded of vegetation, the fine and medium sand in dune ridges is susceptible to wind erosion and drifting. A moderate to low water table can be expected beneath higher dune ridges. Dunes are well drained, and the sand of which they are composed has a low strength when it is not confined. These deposits usually have low compressibility unless sand of a relatively uniform grain size has been deposited in a very loose state. Where dune sand is loose, generally beneath the slip face, it may possess a moderate to low relative density. The bearing strength of dune material

is also low where the sand is unconfined, but can increase with the degree of confinement. Caving of wet and dry sand in vertical ditch walls is a potential problem which can increase costs on major construction jobs. Dune sand is nonplastic and is generally not susceptible to frost action or shrinking and swelling. Most dune deposits provide a good source of sub-base material for highway pavement structures. Where the underlying sub-grade has a high water table, only relatively clean dune sands should be used.

## 3.13 ORGANIC TERRAIN (OT):

### 3.13.1 Description:

Organic terrain includes varying depths of peat and muck in marshes, swamps, fens, and bogs. No attempt was made to separate these organic landscape types during the mapping. Although peat and muck deposits usually occur as relatively thin surficial layers, in places these organic materials can be several metres thick. Moreover, the thickness of the deposits can change drastically over very short distances.

### 3.13.2 Occurrence:

Organic deposits, some of them covering a considerable area, occur in poorly drained depressions throughout the Heaven Lake map-area, particularly the western half.

### 3.13.3 Engineering and Planning Significance:

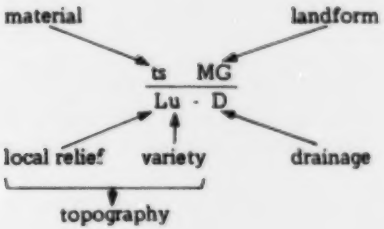
Although organic deposits are commonly thin, they are nonetheless very poor foundation and construction materials. The water table is at or near ground surface for most of the year. The locations of deeper pockets of organic material are difficult to predict reliably without extensive test-drilling. The topography of organic terrain is level or slightly depressional. Peat and muck deposits have low shear and bearing strengths and generally low permeability. They are nearly always poorly drained, highly compressible, and are subject to seasonal flooding. Consequently, they are unsuitable for nearly all types of engineering works and for waste disposal.

## 4.0 APPENDIX: EXAMPLES OF TERRAIN UNIT LETTER CODES:

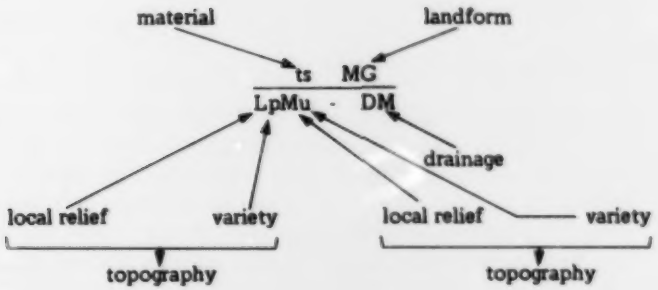
The engineering terrain unit letter codes consist of four components: surface materials, landform, topography, and drainage. The format of the letter codes used in describing the terrain units is discussed in detail in the Users' Manual (Gartner, Mollard, and Roed 1980). Some additional examples of the letter codes are as follows:

### 4.1 SIMPLE TERRAIN UNIT:

**Example 1:**




**Example 2:**

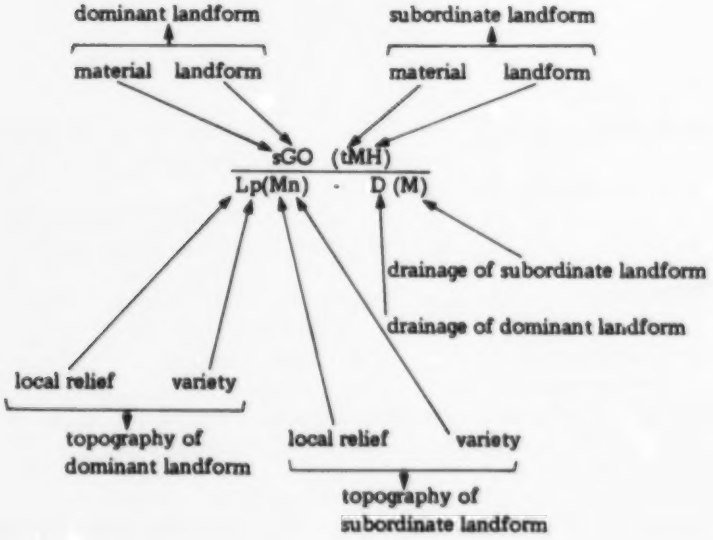



*Note:* The above type of letter code is used where there are two distinctly different types of topography and/or drainage in a simple terrain unit.

## 4.2 COMPLEX TERRAIN UNIT:

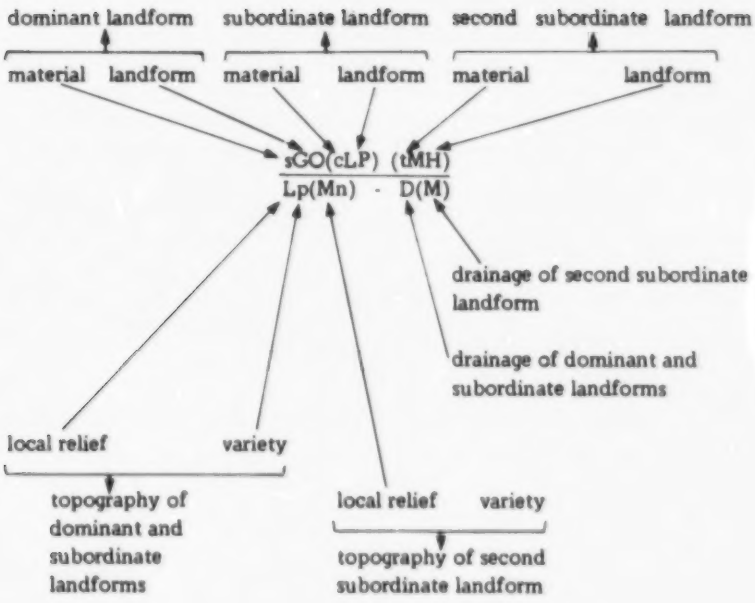
In complex areas, the dominant landform is shown first and the subordinate landform(s) appear in parentheses.

**Example 1:**



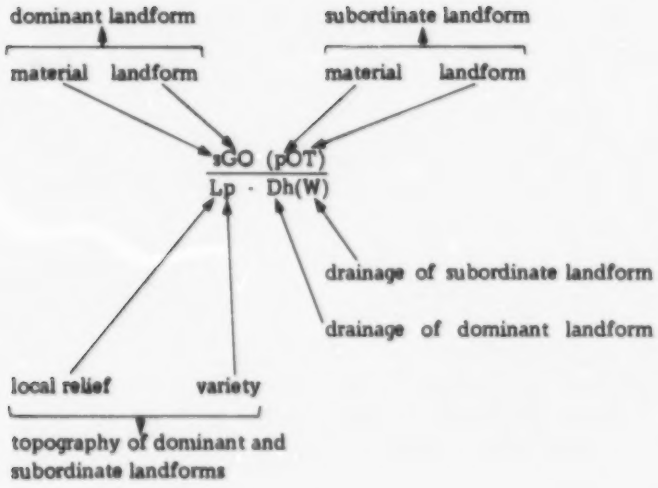

*Note:* The topography and drainage in parentheses refer to the landform shown in parentheses.

**Example 2:**



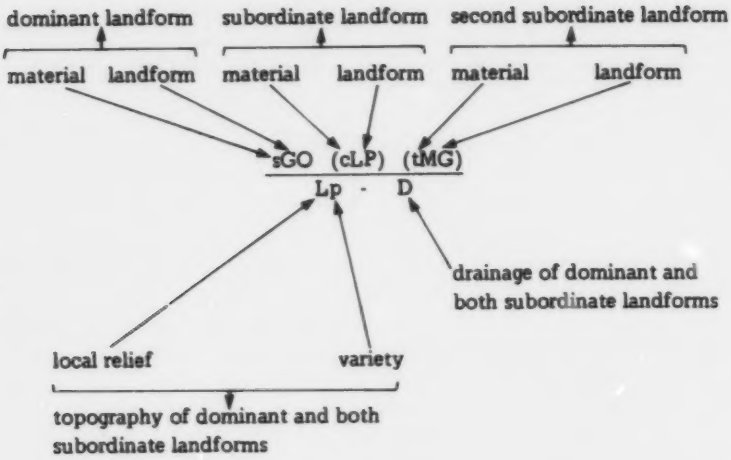

*Note*: The topography and/or drainage in parentheses refer to the second subordinate landform (in parentheses).

**Example 3:**




*Note*: If topography or drainage is similar in the dominant and subordinate landforms, then no topography or drainage symbol is shown in parentheses and the symbol shown applies to both landforms. If topography or drainage conditions are different in one of the landforms, a topography or drainage symbol is shown in parentheses to indicate this difference.

**Example 4:**




*Note:* Where topography and drainage conditions are similar in all of the landforms shown, no topography or drainage symbols are placed in parentheses.

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